DEVICE AND METHOD OF INTERFACING VOICE DATA

5   BETWEEN A SWITCH AND A COMPUTER SYSTEM

BACKGROUND INFORMATION

The invention relates generally to devices and

methods of transmitting voice data between a switch and

10   a computer system, such as those found in telephony

systems. Existing means of transmitting voice data

between a switch and a computer system require a

communication device that is designed to facilitate

communications with one type of switch operating on a

15   switch protocol, and one type of computer system

operating on a computer system protocol. If either the

switch protocol or the computer system protocol, or

both, are changed, the communication device must also be

changed. It is costly to purchase and install a new

20   communication device.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and

objects of the invention, reference should be made to

25   the following detailed description taken in conjunction

with the accompanying drawings, in which:

Figure 1 is a block diagram of an interface device

in accordance with one embodiment of the invention;

Figure 2 is a block diagram of an interface device in accordance with one embodiment of the invention; and

Figures 3A and 3B are a block flow diagram in accordance with one embodiment of the invention.

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DETAILED DESCRIPTION

Briefly, an embodiment of the invention comprises an interface device which includes a user voice data transmission system adapted for connection to a user

10   such as a computer system found in telephony systems, a switch voice data transmission system adapted for connection to a switch such as a private branch exchange ("PBX"), and a programmable controller in communication with the user voice data transmission system and the

15   switch voice data transmission system. The controller is programmable according to programming parameters to enable receipt of voice data via the user voice data transmission system and to enable sending of voice data via the switch voice data transmission system. Thus,

20   the interface device may be programmed to accommodate a user operating on one protocol, and if the user is replaced with another user operating on a different protocol, the interface device need not be replaced but simply reprogrammed.

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Figures 1 and 2 show an interface device **10** in

accordance with one embodiment of the invention. The

interface device **10** may have a user voice data

transmission system **13** and a switch voice data

5   transmission system **16**. When in use, the user voice

data transmission system **13** may be capable of reading

and storing voice data provided by a user (herein

referred to as "user voice data"), and may be capable of

providing the user voice data to a switch **19**, such as a

10   private branch exchange ("PBX"). The switch voice data

transmission system **16** may be capable of reading and

storing voice data from the switch **19** (herein referred

to as "switch voice data"), and providing the switch

voice data to the user. The user may be a computer

15   system, such as those found in telephony systems. For

example, the user may be a voice processing device on a

localized time division multiplexed ("TDM") interface,

such as a voice bus resource card.

Figure 2 shows the interface device **10**in more

20   detail. The user voice data transmission system **13** may

be in the form of a user data storage device **22** that may

be capable of storing user voice data provided by the

user, and that may be capable of providing that user

voice data to the switch **19** at the proper time. The

user data storage device **22** may include a receiving

storage device **25** and a sending storage device **28**. The

receiving storage device **25** may be capable of storing

the user voice data until the sending storage device **28**

5   is ready to accept the user voice data stored in the

receiving storage device **25**. The sending storage device

may be capable of storing the user voice data from the

receiving storage device **25** until the switch **19** is ready

to accept the user voice data stored in the sending

10   storage device **28**.

The receiving storage device **25** may include a

serial-parallel register **31**, an intermediate register **34**

having a receiving port **37** in communication with the

serial-parallel register **31**, and a sending port **40** in

15   communication with the sending storage device **28**. The

sending storage device **28** may include a parallel-serial

register, and the intermediate register **34** may include a

parallel-parallel register.

The switch voice data transmission system **16** may be

20   in the form of a switch data storage device **43** that is

capable of storing switch voice data provided by the

switch **19** and providing that switch voice data to the

user at the proper time. The switch data storage device

43 may include a receiving storage device **46** and a

sending storage device **49**. The receiving storage device **46** may be capable of storing the switch voice data until the sending storage device **49** is ready to accept switch voice data stored in the receiving storage device **46**.

5   The sending storage device **49** may be capable of storing the switch voice data from the receiving storage device **46** until the user is ready to accept the switch voice data stored in the sending storage device **49**. The sending storage device **49** may include a parallel-serial

10   register.

The receiving storage device **46** may include an intake register **52** and an intermediate register **55**. The intermediate register **55** may have a receiving port **58** in communication with the intake register **52** and has a

15   sending port **61** in communication with the sending storage device **49**. The intermediate register **55** may include a parallel-parallel register, and the intake register **52** may include a serial-parallel register.

Referring to Figure 1, the interface device **10** may

20   also include a programmable controller **64** in communication with the user voice data transmission system **13**, and in communication with the switch voice data transmission system **16**. The controller **64** may be programmable according to programming parameters. The

programming parameters may be provided by an application

developer via a control logic interface **67** using, for

example, a personal computer to view a display provided

by the control logic interface **67**. The programming

5   parameters may include a clock polarity, a polarity of a

frame synchronization signal, a clock signal rate, and a

frame synchronization signal location. The programming

parameters may also include a source of a clock signal

and a source of a frame synchronization signal. By

10   knowing information about the type of user to be

connected to the interface device **10**, the application

developer can program the interface device **10** so that

user voice data is properly read by the user voice data

transmission system **13**, and so that the switch voice

15   data is properly provided to the user by the switch

voice data transmission system **16**.

For example, in known TDM systems the polarity of

the frame synchronization signal may be inverted or non-

inverted, and so the interface device **10** may be

20   programmed to accommodate both types of systems. Other

variations between known TDM systems, such as the clock

signal rate, the clock polarity (the time, relative to a

rising edge or a falling edge of the clock signal, when

data is sampled) and the frame synchronization signal

25   location (relative to the start of a frame) may be

programmed into the interface device **10**. For example,

the interface device **10** may be programmed to accommodate

a clock signal rate of 4.096 MHz, 2.048 MHz or 8.192

MHz. For any particular clock signal rate, existing TDM

5   systems have a standard number of time slots and the

location of the time slots containing voice data is also

standard. Therefore, when the user is a TDM system, by

programming the clock signal rate the controller is also

programmed for the number of time slots per frame, and

10   is also programmed for which time slots may contain

voice data. To accommodate users that do not operate on

the existing TDM system formats, the number of time

slots per frame and the time slots within a frame that

may contain voice data may be included among the

15   programming parameters.

The interface device **10** may be programmed to

accommodate a frame synchronization signal location that

straddles a frame boundary, occurs during the last bit

time of a previous frame, occurs during a first bit time

20   of a frame, or envelopes a voice data slot. The source

of the clock signal may be programmed to be the

interface device **10** or the user. The source of the

frame synchronization signal may also be programmed to

be the interface device **10** or the user.

Once programmed with the programming parameters,

the controller **64** may be capable of (a) instructing the

user voice data transmission system **13** to read the user

voice data according to the programming parameters, (b)

5   instructing the user data storage device **22** to store the

user voice data, and (c) instructing the user data

storage device **22** to provide the stored user voice data

to the switch **19**. The programmed controller **64** may also

be capable of (a) instructing the switch voice data

10   transmission system **16** to read the switch voice data

according to the programming parameters, (b) instructing

the switch data storage device **43** to store the switch

voice data, and (c) instructing the switch data storage

device **43** to provide the stored switch voice data to the

15   user in a format according to the programming

parameters.

As shown in Figure 2, the interface device **10** may

further include a bit clock **70** that is capable of

providing a clock signal to the user at the programmed

20   clock signal rate. When the interface device **10** is

provided with the bit clock **70**, the programming

parameters may include a clock signal source programming

parameter to specify whether the clock signal is

provided by the bit clock **70** of the interface device **10**

or by the user. To accommodate users that provide the

clock signal, the interface device may include a clock

signal port **73** for receiving a clock signal from the

user. The clock signal port **73** may also be used to

5   provide the clock signal to the user.

The clock signal (regardless of its source) may be

used by the controller **64** to control the user voice data

transmission system **13** and the switch voice data

transmission system **16**. For example, the controller **64**

10   may be capable of instructing the user voice data

transmission system **13** to read and shift data into the

user data storage device **22** on a rising edge or a

falling edge of the clock signal. An additional

programming parameter may be provided to allow an

15   application developer to specify whether the controller

64 should instruct user voice data to be read and

shifted into the user data storage device **22** on a rising

edge or a falling edge of the clock signal.

Furthermore, the controller **64** may be capable of being

20   programmed to instruct the switch voice data

transmission system **16** to shift data out of the switch

data storage device **43** to the user on a falling edge or

a rising edge of the clock signal. An additional

programming parameter may be provided to allow the

application developer to specify whether the controller

64 should instruct user voice data to be shifted out of

the switch data storage device **43** on a falling edge or a

rising edge of the clock signal.

5   In one embodiment of the invention, a programming

parameter referred to herein as the "clock polarity" may

be used to program the controller **64** to shift data into

(from the user) and out of (to the user) the voice data

transmission systems **13, 16**. In this embodiment, when

10   the controller **64** is programmed such that the clock

polarity is programmed as a "non-inverted" state, user

voice data is shifted into the user data storage device

22 on a rising edge of the clock signal, and switch

voice data is shifted out of the switch data storage

15   device **43** on a falling edge of the clock signal.

However, when the controller **64** is programmed such that

the clock polarity is programmed as an "inverted" state,

user voice data is shifted into the user data storage

device **22** on a falling edge of the clock signal, and

20   switch voice data is shifted out of the switch data

storage device **43** on a rising edge of the clock signal.

The interface device **10** may further include a frame

synchronization signal generator **76** that may be capable

of providing a frame synchronization signal to the user.

When the interface device **10** is provided with the frame

synchronization signal generator **76,** the programming

parameters may include the option to specify the source

of the frame synchronization signal. For example, the

5   frame synchronization signal source may be programmed to

be the interface device **10** or the user. To accommodate

users that provide the frame synchronization signal, the

interface device **10** may include a frame synchronization

signal port **78** for receiving the frame synchronization

10   signal from the user. The frame synchronization signal

port **78** may also be used to provide the frame

synchronization signal to the user. The controller **64**

may be capable of using the frame synchronization signal

(regardless of the source of the signal) to control the

15   user voice data transmission system **13** and the switch

voice data transmission system **16** to indicate the

location of the start of a frame, and thereby, the slot

within the frame that corresponds to the voice data.

The interface device **10** may further include a

20   network common frame synchronization signal generator **79**

and a frame reference signal port **82.** The network

common frame synchronization signal generator **79** may be

capable of providing to the user a network common frame

synchronization signal that is oscillating at a rate

substantially equal to an oscillation rate of a frame

reference signal provided at the frame reference signal

port **82**. However, when no frame reference signal is

provided at the frame reference signal port **82,** an

5   internal clock **85** of the interface device **10** may be used

to provide the oscillation rate to the network common

frame synchronization signal generator **79.**

    In an embodiment of the invention, the interface

device may have a frame synchronization signal generator

10   **76,** a network common frame synchronization signal

generator **79,** a frame reference signal port **82** and an

internal clock **85.** The programming parameters may

include a source of the frame synchronization signal.

In this embodiment, when the source of the frame

15   synchronization signal is programmed to be the interface

device **10,** then (a) if a frame reference signal is

provided at the frame reference signal port **82,** the

interface device **10** may provide the network common frame

synchronization signal to the user with an oscillation

20   rate that is substantially equal to an oscillation rate

of the frame reference signal, and (b) if no frame

reference signal is provided at the frame reference

signal port **82,** the interface device **10** may provide the

network common frame synchronization signal to the user

with an oscillation rate that is substantially equal to
an oscillation rate of the internal clock **85**.

In an embodiment of the invention, when the source
of the frame synchronization signal is programmed to be

5   the user, synchronization of the frame synchronization
signal to the network common frame synchronization
signal may be the task of the user. However, when the
source of the frame synchronization signal is programmed
to be the interface device **10**, the controller **64** may be

10   responsible for synchronizing the frame synchronization
signal to the network common frame synchronization
signal. Therefore, the interface device **10** may be
provided with circuitry capable of accomplishing this
synchronization.

15   Figures 3A and 3B illustrate a method of
interfacing according to the invention. The method may
include providing an interface device **100** having a user
voice data transmission system, a switch voice data
transmission system and a programmable controller in

20   communication with the transmission systems. Those are
the components designated 13, 16 and 64 in Figures 1 and
2. A user may be connected **103** to the user voice data
transmission system, and a switch may be connected **106**
to the switch voice data transmission system. The

25   controller may be programmed **109** by setting programming

parameters specified by the user. The programming

parameters may include a polarity of a frame

synchronization signal, a clock signal rate, a frame

synchronization signal location, a polarity of a clock

5   signal, a source of a clock signal, a source of a frame

synchronization signal, and time slots within the frame

that may contain voice data. The number of time slots

per frame may be thought of as a programming parameter,

however, in existing systems the number of time slots

10   per frame is dictated by the clock rate.

Voice data from the user may be provided **112** to the

user voice data transmission system, and read **115**

according to the programming parameters. The read voice

data may be stored **118** in the user voice data

15   transmission system. Then the stored voice data may be

provided **121** to the switch.

The method may include synchronization of a frame

synchronization signal to a network common frame

synchronization signal. For example, the programming

20   parameter corresponding to the source of a frame

synchronization signal may be set as the interface

device. The frame synchronization signal may be

provided, and synchronized to the network common frame

synchronization signal, for example, by the controller.

The method may also include providing **124** voice

data from the switch to the switch voice data

transmission system, reading **127** the voice data from the

switch and storing **130** the voice data from the switch in

5   the switch voice data transmission system. Then stored

voice data from the switch is provided **133** to the user

according to the programming parameters.

It may be appreciated that the invention provides a

programmable device for and method of interfacing

10   between a user, such as a TDM interface of a computer

system, and a switch, such as a PBX. For example, an

interface device according to the invention may be

programmed to accommodate a first user operating on one

protocol, and if the first user is replaced with a

15   second user operating on another protocol, then the

interface device need not be replaced: The interface

device only needs to be reprogrammed.

Although the invention has been described with

respect to one or more particular embodiments, it will

20   be understood that other embodiments of the invention

may be made without departing from the spirit and scope

of the invention.